

Probing the Physics of Mix

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In 2002 Scannapieco and Cheng developed a multifluid theory (SC model) exhibiting direct interpenetration via a difference in the partial pressures of species. They adopted a Prandtl mixing hypothesis that was used successfully to obtain agreement with inertial confinement fusion experiments. Of course, other models have been developed as well to explain mix on an empirical basis. The diversity of ideas brought to bear on this problem serves to emphasize that experiments on mix can be explained in an empirical fashion from various perspectives.

The SC theory derives a set of multifluid hydrodynamic conservation equations, in which mass, momentum, and energy may be transferred between species. It employs a minimalist approach through its use of a single-fitting parameter to characterize momentum and energy transfer. In this sense it is appealing, though daunting, to inquire into the microscopic basis of the SC model.

We have begun to develop an *ab initio* theory to replace the Prandtl hypothesis of the original SC model. We show that the SC mixing length can be expressed in terms of the screening length of a plasma. On one hand, this parameter, which is difficult to obtain from first principles, may be obtained by fitting to experiments involving mix.

Alternatively, we have begun a program to calculate the screening length from first principles. Initial calculations using classical field theory suggest that lowest-order corrections can be significant when the temperature and number density is sufficiently low. This situation is likely to occur in the vicinity of the edge of the distribution of a heavy specie that has penetrated into a light specie. Our method provides an accurate estimate of the mixing length due to atomic scale phenomena. If this turns out to be insufficient to explain experimental results, it will aid in the future development of a more fundamental *stirring* (turbulence) model applicable on a longer scale.

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